Specific country information for Portugal

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1. Country resource

Offshore wind

Although the potential for offshore wind is not as significant in Portuguese waters as compared with other northern European coastlines, calculated values indicate annual average speeds of 7-8 m/s off the Portuguese coast.

Wave

The west coast of Portugal presents good conditions for large-scale wave energy implementation, with the resource generally decreasing from north to south (35-40kW/m north to 25kW/m southwest). Overall, the best conditions are found in the northern part of continental Portugal and the Autonomous Regions, taking into account of the type of sea bed, conflicts of use, and the resource.

Tidal stream

Only the estuaries of the larger rivers (e.g. Douro, Tejo, Sado, Guadiana, Lima) and some specific locations at the coastline may be of relevance. At the present stage of technology development, average flow levels are not generally considered attractive for commercial exploration.

Run-of-River

Due to the high level of hydropower implementation and the seasonal and annual variation of rainfall and flow levels in Portugal, development of the run-of-river sector is generally not considered a major option at this stage.

Tidal Range

Once technology for this sector has advanced, tidal impoundment could possibly be an option for the coastline, due to the relatively moderate tidal variations (1.5 – 3.5m peak level differences).

2. Development and testing

2.1. Research and development institutions and facilities

Research and development (R&D) into aquatic renewable energy in Portugal has been rather limited to theoretical or small-scale model testing.

A number of Portuguese universities – namely, the IST (Instituto Superior Técnico), FEUP (Engineering Faculty of Porto University) and Aveiro University - have been involved in a wide range of R&D activities for aquatic renewable energy.

Some research, for example, on the wave energy resource and hydrodynamics, has been carried out by the INETI (National Institute of Innovation and Technology). However, the INETI has now closed, and has been replaced by the new National Laboratory for Energy and Geology (LNEG).

The non-profit association Wave Energy Centre (WavEC) is involved in wave energy R&D activities in fields where there is a lack of knowledge, or where this is desired by its associates.

Of the larger companies, only Martifer runs its own R&D in wave energy. Efacec undertakes R&D and innovation work on electronic components. In terms of small-to-medium enterprises, Kymaner, founded in particular for wave energy technology development, puts research efforts into mechanical issues.

2.2. Technology and design testing facilities

In terms of Portuguese facilities for testing of aquatic renewable energy technology, the test installations available are mainly suitable for small-scale laboratory (hydrodynamic) tests, with installations available at IST (Instituto Superior Técnico), LNEC (National Civil Engineering Laboratory) and FEUP (Engineering Faculty of Porto University).

Electronic components can be tested in the respective University laboratories or some installations of commercial entities.

The OWC (oscillating water column) wave energy pilot plant on the Island of Pico/Azores, is currently being proposed by WavEC as a real-scale test bed for air turbines. A wave energy pilot zone is being planned for testing and demonstrating wav energy devices under special conditions.

2.3. Pilot zones and trial projects

There is no significant potential for tidal stream, range or run-of-river in Portugal. There have been no initiatives for these technologies.

Despite the presence of the resource, offshore wind energy has not been considered for Portugal due to the steep continental shelf, which would make project design more difficult, and also mean projects must be closer to the shoreline. Offshore wind has only recently started to be recognised due to advances in floating platforms, which will allow development in deep water. The Government has not set up any pilot zones for the encouragement of offshore wind around Portugal.

Development of wave energy around Portugal has been seriously considered. In early 2007, a wave energy pilot zone of 320 km2 was adopted in a proposal of a decree-law, effective in April 2008 (Decree-Law nº5/2008). These zones would be for an installed potential of 80 MW in a first phase, and 250 MW in a second phase. The zone can be seen as highly innovative for Portugal, because of its large size and the fact that the concept was adopted in 2005, early in the development of the wave energy sector both in Portugal and globally. This reflects the strong expectations of wave energy development in Portugal. The time taken for the implementation of the pilot zone is worrying, as between 2005 and now, there has been limited, if any, progress. This will be a critical aspect for this undertaking, and whether wave energy devices can actually be tested by 2010.

3. Power use and transmission

3.1. Power use options

Portugal faces a significant deficit of electricity production and security of supply, particularly during "dry" years with limited rainfall, due to its large dependence on hydropower. Electricity production to the national (or regional) grid is therefore of high priority for aquatic renewable energy; however, their limited suitability for base load production certainly makes storage a potentially important component.

As run-of-river potential naturally coincides with hydropower potential, it could be used to expand the pump storage capacity of hydropower dams.

Microgeneration from aquatic renewable energy is likely to play a minor role in remote areas with characteristically isolated communities where grid connection is weak at best. On the Islands (e.g. Azores & Madeira archipelagos), microgeneration is likely to be feasible in some niche areas due to the large wave energy potential and insufficient grid infrastructure.

Heat energy and electricity are unlikely applications for aquatic renewable energy in Portugal, although wave energy could potentially contribute to heating needs in some areas during the winter months.

3.2. Grid network

The Portuguese electrical grid is strongly orientated in a north to south direction, with its backbone close to the coastline. Wave energy, and potentially offshore wind energy, is thereby appropriate for Portugal. Even with large-scale implementation of aquatic renewable energy, the challenges to the existing grid could be controlled. As with onshore wind energy, for instance, a weak grid in areas with resource availability has been a major obstacle to implementation.

Only a limited number of run-of-river projects are viable for Portugal. These small and micro installations of run-of-river will not pose a problem to the grid.

In Portugal, the implementation of new aquatic renewable energy will most likely concentrate on the coastal area, in particular in the northern areas of the country.

3.3. Grid connections for aquatic renewables

A grid connection for an aquatic renewable energy project in Portugal is requested via a "PIP" (Pedido de Informação Prévia – Request of Previous Information). Obtaining this connection can be difficult. The organisation responsible the connection process is DGEG (General Directorate for Energy and Geology – www.dgge.pt). An environmental impact statement, deployment and operational licenses are also required, which are further described in Sections II and III in Part 5.

4. Industry and skills

4.1. Manufacturing capacity

Despite the limited industrial capacity of Portugal in general, there is potential production capacity for aquatic renewable energy. One reason for this is that the country has significant experience with medium and large-scale hydropower, including all adjacent work phases. This experience will be relevant for run-of-river, but also for other aquatic renewable energy technologies.

Mainly in the north Porto area of Aveiro, but also in the Greater Lisbon area, there are industrial capacities for device and support structure manufacture. There are a number of cable manufacturers with proven capacities, as well as strong coastal engineering contractors and substation suppliers. Several shipyards with significant capacity for the assembly and preparation of devices for deployment and maintenance are also available.

The size of aquatic renewable plants and their modular set-up will help to build new manufacturing capabilities in Portugal. This is a national priority, and is often pursued by regional and local authorities. Peniche township (i.e. southern-central Portugal) for instance, has reserved large areas for potential wave energy manufactures.

4.2. Support facilities and vessels

The transport and harbour/port infrastructure will be sufficient to support the take-up of the industry. Expansion or adjustments to the layout of some harbour areas will be required once large-scale implementation takes place. Several areas have the potential for such a development, which is why transport and harbour infrastructure will not inhibit the growth of aquatic renewable energy sectors in Portugal.

Vessel availability for aquatic renewable energy deployment and maintenance may be limited with only tug boats and other generic vessels available, as opposed to specialised working vessels. This may potentially be a limiting factor, much more so than harbour/transport infrastructure availability, in the early stages of the aquatic renewable energy sectors in Portugal. The deployment of the Pelamis machines off the coast of Póvoa de Varzim in 2008 demonstrated the potential difficulties due to the absence of specialised and sufficiently sized working vessels. Similarly, a working vessel had to be rented from the Netherlands for the AWS pilot plant tests in 2004.

There is strong will and potential in Portugal to grow a domestic aquatic renewable energy industry. This is for energy purposes but also in order to support the rather weak employment market and industrial structure. However, due to a lack of experience and rather moderate financial options, some of the structural weaknesses may take longer to overcome than intended.

4.3. Workforce

The availability of sufficiently trained people to support the development of aquatic renewable energy projects in Portugal is not critical in the initial phase, as all required skills are available in related industrial branches, and unemployment levels are high and increasing.

Some human resource requirements may be in short supply when commercial scale deployment takes place. On the other hand, several relevant specialists, such as construction, manufacturing and engineering consultants, have suffered from recession, which would lead to benefit a growth in the aquatic renewable energy sector, and in particular, the wave energy market segment. There will be time for human resources to grow together with the sector, at a similar pace to the extra required infrastructure.

4.4. Educational institutes

There are several major Universities in Portugal which could provide a reasonable quantity and quality of relevant technical education for workers in the aquatic renewable energy industry. With respect to non-academic degrees, some structural weaknesses in the educational system have meant that technical professions cannot easily be learned other than through work experience. The concept of practically-oriented professional schools has traditionally not been pursued in Portugal.

Engineering degrees can be obtained in the major technical schools such as IST (Instituto Superior Técnico), FEUP (Engineering Faculty of Porto University), Aveiro University, Coimbra University, and New University of Lisbon, as well as polytechnic institutes countrywide.

Some of these schools have dedicated renewable energy master modules, and in some cases focus on aquatic renewable energy, as part of engineering degrees.

5. Regulation

5.1. Leasing

The concept of purchasing or leasing sea-use is not common in Portuguese legislation. For aquatic renewable energy projects, only run-of-river has been traditionally subject to this situation. When sections of rivers are part of private space, their use has to be licensed in the context of land-use planning, requiring an exploration license for the aquatic resource.

Traditionally, the sea was not used for energy generation. Substantial changes are expected in the context of the national application of the water framework law; however, this may not necessarily involve land and sea lease or purchase.

5.2. Consenting

Developers of aquatic renewable energy projects require four licenses in order to pursue development:

- License of water use
- License for construction (prior environmental consent required)
- License for establishment
- License for exploitation

Whereas the first two licenses have to be obtained from the regulatory body for water (INAG – the Water Institute www.inag.pt), the latter are granted by the Directorate General for Energy and Geology (DGEG – www.dgge.pt). A grid connection point must be requested from this same body ("PIP" – Pedido de Informação Prévia)

5.3. Environment

For any project involving construction in a body of water, environmental consent is required. No specific rules have been documented to date for most aquatic renewable energy projects. Small hydropower (i.e. the regime under which run of river plants would fall), an environmental incidence study is required. For larger projects (e.g. coastal structures), a more comprehensive environmental impact study is needed.

The Wave Energy Centre (WavEC) has been working on environmental issues and generating conclusions for consent issues, with respect to wave energy, and in terms of large-scale deployments and the wave energy pilot zone (see Part 2, Section III).

Challenging, but not insurmountable, issues for the licensing of aquatic renewable energy are naturally Rede Natura 2000 sites, as well as sites under special national protection regime (REN – Reserva Ecológica Nacional). Whereas Rede Natura 2000 covers wide areas of the coastline in mostly shallow waters, and do not pose a major obstacle to some aquatic renewable energy projects, REN can impose more specific and less flexible restrictions.

A critical player in the context of environmental licenses is the newly created environmental agency, APA – Agência Portuguesa do Ambiente

(http://www.apambiente.pt/Paginas/default.aspx).

5.4. Health and Safety

There is no specific health and safety regulation related to aquatic renewable energy. Due to the lack of offshore oil and gas industry, the maritime sector has not yet been subject of specific health and safety rules. For construction activities, and in the context of operation or maintenance, the specific regulations for construction yards and maritime activities have to be taken into account, as well as several European Directives transposed into national law.

The most relevant health and safety decree-laws include:

- DL 441/91: establishes the legal regime for safety, hygiene and health at work;
- DL 280/93: establishes legal regime for harbour works;
- DL 347/93: minimum safety and health prescriptions at work; transposition of EC Directive 89/654/CEE;
- DL 12/94: approves regulations for professional diving;
- DL 26/94: organisation and functioning of health and safety activities at work;
- DL 100/97: work accidents and professional sicknesses;
- DL 273/2003: revision of the regulation of safety and health conditions for work in temporary or movable construction yards as set out in DL 155/95; incorporating minimum prescriptions according to EC Directive 92/57/CEE.

6. Drivers of industry

6.1. Political drivers

There has been substantial political will for the development of renewable technologies in Portugal. Since 2000, the opportunity for renewable energy implementation on a large-scale has been recognised by the government, in particular with respect to marine renewable energy.

There are a number of legislative documents demonstrating the will to reduce Portugal's dependence of fossil fuels and reduce pollution. The first legal documents date back to 1988 which established rules for independent producers. Since 1999, and in particular from 2001 onwards, when clear feed-in tariffs for renewable energy were established, the baseline for strong renewable energy implementation was recognised by government officials.

In early 2007, the creation of a wave energy pilot and demonstration zone, with facilitated access and a subsidised tariff, was announced. This was established by law in February 2008 (see section III of Part 2), re-introducing the tariff of approximately 25cEUR/kWh. This represents the level of expectations in Portugal for energy conversion from ocean waves.

Other aquatic resources are less important from a national strategic viewpoint, due to a high grade of saturation (e.g. hydro power), limited resource (e.g. tidal energy & river flow), or non-favourable geographic parameters (e.g. offshore wind). Most of the information is biased towards wave energy, which is seen as the most promising source, along with onshore wind energy, where there has been a substantial increase of installed potential since removal of legal barriers in 2004-2005, and solar energy, where there are several multi-MW projects being built or planned.

Surveys carried out by WavEC since 2004 indicate that there is wide public support for wave energy implementation, if proper information and dissemination measures are taken beforehand.

6.2. Financial drivers

In general, Portugal offers the two most common support mechanisms, simultaneously: revenue support via established feed-in tariffs, and grant support for demonstration projects, and to a smaller extent, for established aquatic renewable plants. Fully or partially refundable credits and tax credits are also part of the financial support mechanisms in Portugal.

The feed-in tariff is defined by law within certain limits. For example, for small hydropower the tariff is slightly above 7cEUR/kWh, and for wave energy it is approximately 25cEUR/kWh initially, decreasing towards 16-18cEUR/kWh in a pre-commercial phase and finally yielding < 10cEUR/kWh in a commercial phase. Tidal energy and offshore wind have not yet been considered in the legislation. The feed-in tariff is guaranteed and may be negotiable in some cases, once that the grid connection is granted (DGEG – www.dgge.pt).

Capital grants and other mechanisms are typically administered by ADI (Innovation Agency – www.adi.pt), in the context of the Ministry for Economy.

The private finance market has started to invest in aquatic renewable energy, mainly in wave energy projects or individual developers. To date this has mostly involved project developers of similar technologies and mainly wind technologies, whereas investment from venture capital funds and pure finance companies is in the initial phase.